

REMARKS

This paper is in response to the official action dated June 29, 2004 (hereafter, "the official action"). This paper is timely-filed.

Prior to entry of the foregoing amendments, claims 1-61 were pending. By the foregoing amendments, claims 1, 9, 22, 28, 42, and 50 have been amended, claims 7, 8, 26, 27, 48, and 49 have been canceled, and new claims 62 through 67 have been added. Enclosed herewith is a check covering the filing fee of \$172 for two additional independent claims in excess three. No fee is due for adding six additional claims in excess of the highest number previously paid for because six claims have been canceled from this application.

Support for the amendments to the claims may be found, for example, at the second paragraph of page 3 of the specification and in the claims as originally filed. Support for added claims 62-67 may be found, for example, at the first paragraph of page 3 and in the claims as originally filed. No new matter has been added.

Additionally, Figure 1 of the drawings has been amended to include the designation "Prior Art," and the specification has been amended to include appropriate section headings to better conform the application with U.S. practice.

Claims 1-12, 14, 15, 17, 18, 21-31, 33, 34, 36-38, 41-53, 55, 56, 58, and 61 have been rejected under 35 U.S.C. §103(a) as obvious over U.S. Patent No. 6,137,223 to Hung *et al.* ("Hung *et al.*") in view of U.S. Patent No. 6,395,409 to Ueda *et al.* ("Ueda *et al.*"). Claims 16, 35, and 57 have been rejected under 35 U.S.C. §103(a) as obvious over Hung *et al.* in view of U.S. Patent No. 4,356,429 to Tang ("Tang"). Claims 19, 20, 39, 40, 59, and 60 have been rejected under 35 U.S.C. §103(a) as obvious over Hung *et al.* in view of U.S. Patent No. 6,452,218 to Cao ("Cao").

Claims 13, 32, and 54 have been objected to, but are allowable in substance.

The various bases for the claim rejections are addressed below in the order presented in the official action. Reconsideration of the application, in view of the foregoing amendments and the following remarks, is solicited.

CLAIM REJECTIONS -- 35 U.S.C. §103(a)

A *prima facie* case of obviousness *requires* three basic criteria. *First*, there must be some suggestion or motivation, either in the references themselves, or in knowledge generally available to one of ordinary skill in the art, to modify a reference or to combine reference teachings. *Second*, there must be a reasonable expectation of success in doing so. *Third*, prior art references, when combined, must teach or suggest all of the claim limitations. See M.P.E.P. §2142.

Claims 1-12, 14, 15, 17, 18, 21-31, 33, 34, 36-38, 41-53, 55, 56, 58, and 61

The applicants respectfully traverse the rejections of claims 1-12, 14, 15, 17, 18, 21-31, 33, 34, 36-38, 41-53, 55, 56, 58, and 61 as obvious over Hung *et al.* in view of Ueda *et al.* because at least the first and third criteria of the *prima facie* case of obviousness have not been satisfied, as explained in more detail below. Accordingly, the rejections of claims 1-12, 14, 15, 17, 18, 21-31, 33, 34, 36-38, 41-53, 55, 56, 58, and 61 as obvious over Hung *et al.* in view of Ueda *et al.* should be withdrawn.

Hung *et al.* disclose organic light-emitting devices comprising a substrate (502); an anode (504) disposed over the substrate; an organic light-emitting structure (520) disposed over the anode; an organic cathode buffer layer (530) disposed over the organic light-emitting structure, which is formed from a material selected to protect the organic light-emitting structure from damage caused by the high energy deposition of a cathode over the organic light-emitting structure (*see* Hung *et al.* at column 9, line 66 through column 10, line 10); a dopant layer (532) disposed over the cathode buffer layer, which comprises an electron-injecting dopant comprising a group 1 or group 2 metal having a work function of less than 4.0 eV (*see* Hung *et al.* at column 10, lines 11-15 and lines 47-51); and, a cathode (510) disposed over the dopant layer, which comprises a metal, a metal alloy, or a light transmissive metal oxide having a work function greater than 4.0 eV (*see* Hung *et al.* at column 10, lines 22-32).

The organic cathode buffer layer material invariably comprises a porphyrinic compound (*see* Hung *et al.* at column 11, line 1 through column 12, line 32). Additionally, at least a portion of the dopant layer diffuses across the organic cathode buffer layer to form an interfacial electron-injecting layer at an interface between the

dopant layer and the organic light-emitting structure (*see Hung et al.* at column 10, lines 13-21 and lines 52-67).

Hung *et al.* therefore does not disclose or suggest an opto-electrical device comprising an anode electrode, a cathode electrode, and an opto-electrically active region located between the electrodes, wherein the cathode electrode includes a first layer comprising a compound or an organic complex of a group 1 metal, a group 2 metal, or a transition metal; a second layer comprising a material having a work function below 3.5 eV; and a third layer spaced from the opto-electrically active region by the first and second layers and having a work function above 3.5eV, wherein the first layer is spaced from the opto-electrically active region by the second layer, as recited by claims 1-61.

Because "Hung does not specifically disclose that the material is a *compound* of the group I, group II, or transition metal," the examiner turned to Ueda *et al.* *See* official action at page 2 (emphasis in original). Figures 2 and 3 of Ueda *et al.* disclose organic light-emitting devices comprising a substrate; an anode (1) disposed over the substrate; a hole-injection transporting layer (2, 7) disposed over the anode; an optional hole transporting layer (8) disposed over the hole-injection transporting layer; an organic luminous layer (3) disposed over the hole-injection layer; an electron-transporting layer (6) disposed over the organic luminous layer, which comprises an organic charge transporting material (*see Ueda et al.* at column 5, line 66 through column 6, line 12); an electron-injection layer (4) disposed over the electron-transporting layer, which is a composite layer comprising a metal oxide, a metal halide, and a different material therefrom (typically, an organic charge transporting material or a metal) (*see Ueda et al.* at column 4, lines 43-59); and, a cathode (5) disposed over the electron-injection layer, which comprises a metal having a work function of less than 4 eV (*see Ueda et al.* at column 3, lines 6-9).

Thus, Ueda *et al.* also does not disclose or suggest an opto-electrical device comprising an anode electrode, a cathode electrode, and an opto-electrically active region located between the electrodes, wherein the cathode electrode includes a first layer comprising a compound or an organic complex of a group 1 metal, a group 2 metal, or a transition metal; a second layer comprising a material having a work function below 3.5 eV; and a third layer spaced from the opto-electrically active region by the first and second layers and having a work function above 3.5eV,

wherein the first layer is spaced from the opto-electrically active region by the second layer, as recited by claims 1-61.

Moreover, Hung *et al.* explicitly teach depositing an organic buffer layer on a light-emitting region to protect the fragile light-emitting region from damage often caused by high energy metal deposition techniques. A dopant layer must then be provided over the buffer layer, and diffuse therethrough in order for the light-emitting device to function. If the metal dopant layer (532) of Hung *et al.* was replaced with a metal compound (as suggested by the examiner), the device would not function as described by Hung *et al.* because the metal compound would not diffuse across the buffer layer (530). Further, if the buffer layer (530) was replaced with a composite layer comprising a metal oxide, a metal halide, and a different material therefrom, in accordance with Ueda *et al.*, there would be no need for a dopant layer to diffuse through the composite layer for charge injection. Thus, the applicants respectfully submit that the proposed substitution is impermissible because such a substitution would be contrary to the teachings of Hung *et al.*, which unequivocally teaches providing an organic buffer layer to protect the light-emitting region from high energy metal deposition techniques. Thus, there is no motivation to combine these references in the manner proposed by the examiner.

Furthermore, unexpectedly increased efficiencies are observed with opto-electrical devices comprising the claimed three-layer cathode structures when compared with prior art structures. The combination of a layer of a compound of a group 1 metal, a group 2 metal, or a transition metal, a layer comprising a material having a work function below 3.5 eV, and a layer having a work function above 3.5eV has been found to be particularly advantageous, and significantly enhances device performance. As shown in Figure 7, such combinations shows good efficiency, particularly for blue emitters.

It is respectfully submitted that the rejection of claims 1-12, 14, 15, 17, 18, 21-31, 33, 34, 36-38, 41-53, 55, 56, 58, and 61 as obvious over Hung *et al.* in view of Ueda *et al.* should be withdrawn in view of the above comments.

Claims 16, 35, and 57

The applicants respectfully traverse the rejections of claims 16, 35, and 57 as obvious over Hung *et al.* in view of Tang.

Tang *merely* discloses organic light-emitting devices including single-layer cathode structures. Accordingly, its combination with Ueda does not add anything further to the obviousness analysis. It is respectfully submitted that the rejection of claims 16, 35, and 57 as obvious over Hung *et al.* in view of Tang should be withdrawn in view of the above comments.

Claims 19, 20, 39, 40, 59, and 60

The applicants respectfully traverse the rejections of claims 19, 20, 39, 40, 59, and 60 as obvious over Hung *et al.* in view of Cao.

Cao also *merely* discloses organic light-emitting devices including single-layer cathode structures. Accordingly, its combination with Ueda does not add anything further to the obviousness analysis. It is respectfully submitted that the rejection of claims 19, 20, 39, 40, 59, and 60 as obvious over Hung *et al.* in view of Cao should be withdrawn in view of the above comments.

NEW CLAIMS 62-67

New apparatus claims 62-64 recite an opto-electrical device comprising an anode electrode; a transparent cathode electrode; and, an opto-electrically active region located between the electrodes; the cathode electrode including a first layer comprising a compound of a group 1 metal, a group 2 metal, or a transition metal; a second layer comprising a material having a work function below 3.5 eV; and a third layer spaced from the opto-electrically active region by the first and second layers and having a work function above 3.5 eV, wherein the compound is a metal halide or a metal oxide. The art of record does not suggest such a device. It is respectfully submitted that new claims 62-64 should therefore be allowed.

Similarly, new apparatus claims 65-67 recite an opto-electrical device comprising an anode electrode; a cathode electrode; and, an opto-electrically active region capable of generating an electrical field in response to light located between the electrodes; the cathode electrode including a first layer comprising a compound of a group 1 metal, a group 2 metal, or a transition metal; a second layer comprising a material having a work function below 3.5 eV; and a third layer spaced from the opto-electrically active region by the first and second layers and having a work function above 3.5 eV, wherein the compound is a metal halide or a metal oxide. The art of

record does not suggest such a device. It is respectfully submitted that new claims 65-67 should therefore be allowed.

CONCLUSION

It is respectfully submitted that this application is now in condition for allowance. Should the examiner wish to discuss the foregoing, or any matter of form or procedure in an effort to advance this application to allowance, he is respectfully invited to contact the undersigned attorney at the indicated telephone number.

Respectfully submitted,

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September 29, 2004



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IN THE DRAWINGS:

Please amend Figure 1 to include the legend "Prior Art" as set forth in the accompanying Request for Approval of Drawing Changes.